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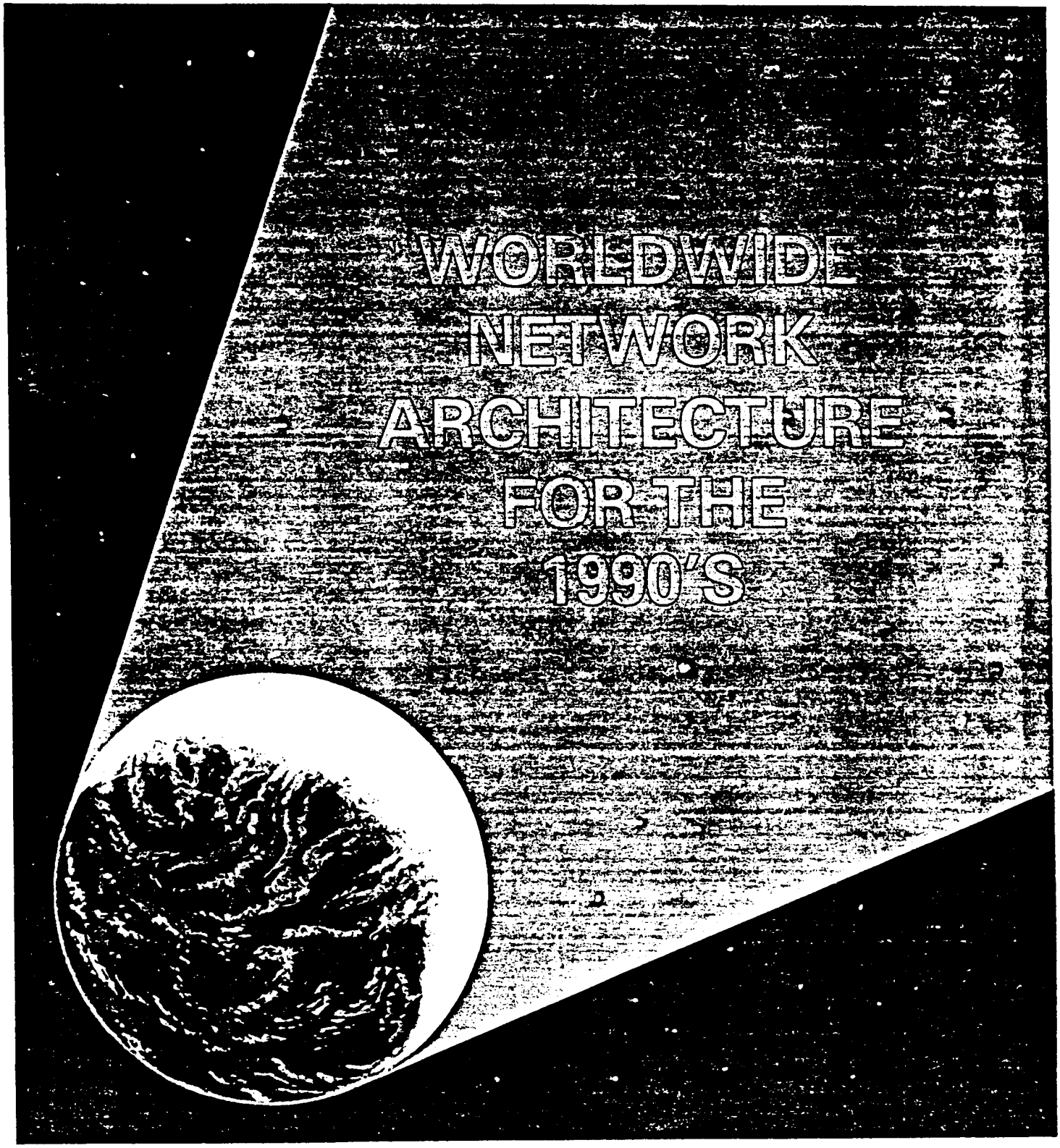
U.S. DEPARTMENT OF STATE
OFFICE OF COMMUNICATIONS



Executive Summary

OVERVIEW

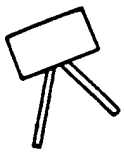
Telecommunications Network Architecture

The Department of State (DOS), Office of Communications (OC), has initiated a major effort to develop a worldwide leased network architecture to accommodate emerging requirements for secure television conferencing, voice, and data. The network concept for a distributed network with hierarchical levels to serve large, medium, and small Foreign Service posts will employ T1 bandwidth capabilities and other high-capacity circuits. The backbone international and domestic networks will be secure, with sufficient redundancy to assure high availability of bandwidth to the Department and to the foreign affairs community.

FOREIGN AFFAIRS CRISIS MANAGEMENT
by DASC Robert C. Ribera
Reprinted from *Signal* magazine.

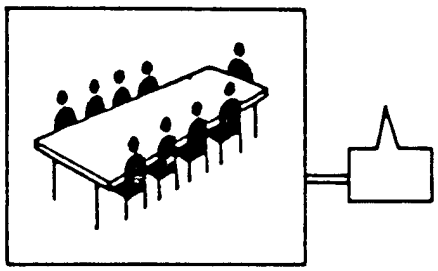
The United States Government depends on its diplomatic missions and consular offices in almost every country around the world to serve as the foreign focal points for the formulation and execution of foreign policy. The command and control of such a farflung operation depends almost entirely on the communication systems which link the approximately 250 locations involved.

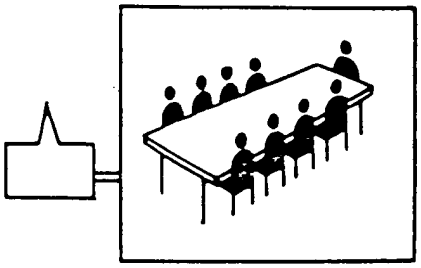
In instances of political unrest, civil strife or natural disaster, the management of the crisis most often requires direct contact between Washington and those on the scene, and the fate of life and property as well as the instances of fast breaking foreign policy implications are dependent on rapid, reliable and secure communications systems.



Our immediate goals are increased band widths; more effective switching systems; multilevel service; enhanced interoperability, reliability and survivability; and always high degrees of communications security and professional networks management.

The challenge is exciting. With the technological advances providing the stimulus, telecommunications facilities will be capable of handling information in virtually every type of electronic form.





Preface

In July 1985, the Deputy Assistant Secretary for Communications (DASC) established a Working Group for the purpose of developing a network architecture to support the ongoing and future telecommunications requirements of the Department and the foreign affairs community.

The Working Group's report contains detailed information regarding the capabilities and characteristics of the international secure network projected for the future. This Executive Summary highlights the effort.

Information regarding the network architecture and other elements proposed may be obtained from the Office of Communications, (703) 644-3206.

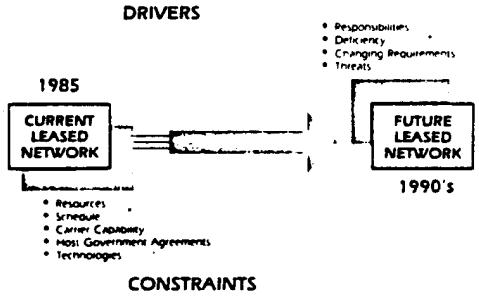
Respectfully Submitted for Consideration
by the
Telecommunications Network Architecture
Working Group

Executive Summary

Introduction

Early on, the Working Group initiated efforts to review the Office of Communication's responsibilities vis-a-vis its expanding carrier role, changing user requirements, network strategies for the architecture, inter-agency agreements for services, and the capabilities and plans of the U.S. International Record Carriers (IRCs).

Developing the basic architecture was made easier since considerable thought had already been given to the subject by Office of Communications activities. This, coupled with the goals and objectives of the network planning established by the Working Group and approved by the Office of Communications Directors, presented a clear direction for the overall effort. The goals and objectives were as follows:



- Ensure that the basic global transmission architecture meets the needs of the U.S. Government at Foreign Service posts and satisfies, to the degree possible, the requirements of the "National Level Agenda" for survivability, continuity, and security.

- Transform present networks into an integrated telecommunications network with voice options and with the capacity and versatility to accommodate the needs of the Department, the foreign affairs community, and other U.S. Government activities, through the mid-1990's.

- Ensure that special communications capabilities are available during crisis and abnormal situations.

- Ensure that each Foreign Service post has a minimum of two completely independent transmission paths to the outside world.

- Ensure that the Backbone Transmission System can accommodate the wide range of user services and that a viable restoration system is in place to effectively use circuitry in the event of reduced capabilities.

- Ensure that negotiations are initiated with appropriate carriers and/or host governments for full-time, non-preemptable services.

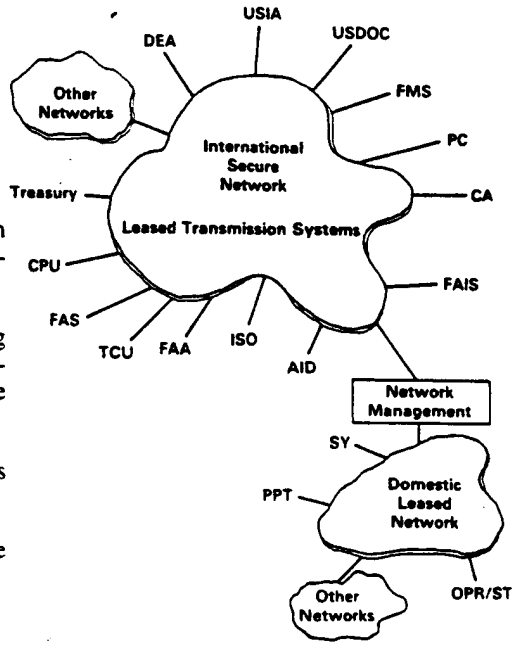
- Ensure that the leased network properly interfaces other member networks and interoperability is possible and agreements reached.

- Ensure that a requirements validation process is established and exercised, and that customer usage is monitored for compliance with agreements.

- Ensure that the network maintains user confidentiality and that all trunks are secure.

- Ensure that there is a responsive distributed network management and control structure, and that a continual examination is conducted of single-thread vulnerabilities and critical paths.

- Ensure the network access points interface with various types of modems and specified protocols, formats, and codes used by the customers.
- Ensure network efficiency by eliminating unnecessary duplicative circuitry and enhanced bandwidth utilization, but ensure extra capacity is available for special situations.
- Ensure that a realistic alternate routing policy is established and a plan is ready for execution.
- Ensure that a viable user requirements data base is maintained.



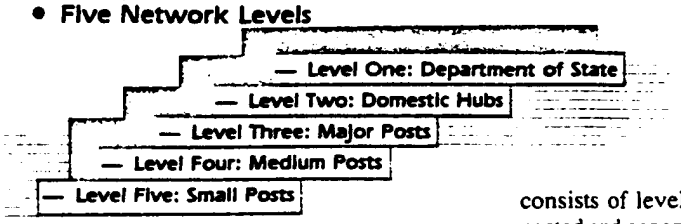
Design

The following illustrates the areas where particular emphasis was placed by the Working Group in developing the network design:

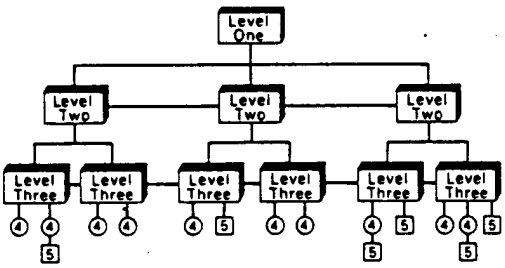
TECHNICAL	NON-TECHNICAL
High Network Availability	Expression of Need From Senior Management
Controllable Network Access	Included in Department Plans
Responsive Network Control	Competent Network Operation
Interoperability Among Member Networks	Supportive Environment
Flexible Degree of Dedication	Reasonable Cost and Schedule
Wide Range of User Services	Feasible Long Term Budget Support
Capable of Maintaining User Confidentially	Restoration Priority
Network Security	Alternative Routing Plan
Efficient Use of Bandwidth	Examination Single-Thread Vulnerabilities
Terminal Flexibility	User Requirements Data Base

Architectural Concept

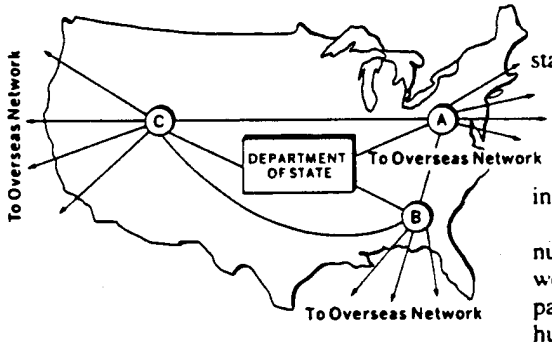
- **Distributed Network**
- **Hierarchical Levels**
- **Five Network Levels**



The backbone network design concept is relatively straighforward and allows for an evolutionary transition from the Department's ongoing dedicated high-speed circuit program to a distributed network with five hierarchical levels. The distributed portion consists of levels one through three being interconnected and generally self-sufficient, whereas levels four and five would be connected in a star configuration to level three.



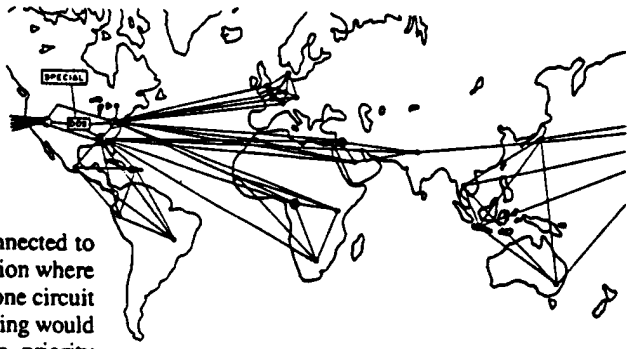
The concept allows for the Department (Level one) to be serviced by three domestic hubs (Level two). This configuration was deemed important to ensure diversity of trunks for high-circuit availability and to minimize the need for sophisticated overseas nodes.



Level 1 to Level 2 Network Configuration

The domestic hubs would be engineered as sister stations to allow for each of the three to service and manage a region, as well as backup the others in the event of a catastrophic failure or scheduled shutdown. Each hub would be functionally identical, thus avoiding additional training for personnel transferred from station-to-station.

The first tier of posts overseas (Level-three) would number between 20-25 locations. Level-three posts would have leased wideband redundant circuits to their parent Level-two hub, as well as another Level-two hub. All Level-three posts would be fully connected, and at least one post in each region would be connected to a Level-three post in another region. This redundancy would accommodate overloading and alternate routing of substantive traffic and circuitry in the event of trunk disruption or crisis volumes. Level-three posts would also have extra capacity to terminate special circuits in support of VIP trips, conferences, and special activities.



Level 1 to 3 Network Configuration

Level-four and -five posts would be connected to their Level-three post in a STAR configuration where each Level-four and -five post would have one circuit into a higher Level-three post. Alternate routing would be achieved by an established restoration priority system utilizing government-owned facilities and/or commercially available dial-up systems.

The proposed architecture creates a global backbone transmission network which provides the communications (bandwidth) connections to a variety of user-oriented systems. The network provides for trunk security. If additional security is needed, the customer may arrange for it to satisfy a particular need. The network will in effect be transparent to the user and allow for the choice of terminal systems by the customer. The planned backbone transmission links consist of a variety of high-capacity digital circuits (1.54 megabit or higher) at the above Level-three posts, and medium (9.6 to 56 Kbps) to low speed (2.4 Kbps) to the Level-four and -five posts. Transoceanic links would be via commercial satellite or submarine cable.

Survivability

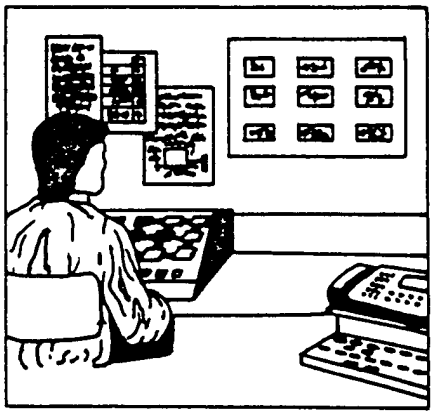
While the goal is to have the backbone trunks grow into a totally survivable network throughout the world, achievement is recognized as highly unlikely.

The architecture provides for a highly distributed network to key Foreign Service posts, with sufficient features to ensure a high degree of survivability. The principal features include network redundancy, dispersion of links, adaptive routing, semi-automatic preemption, and sophisticated around-the-clock network control and management.

An important element of the network architecture is the planned network control and management. A professional network control activity will be essential to ensure that circuit up-time is maintained at a high level and that alternate routing plans can be executed as warranted in a timely manner. Effective network management will result in high performance and cost avoidance. The three domestic hubs will pay a key role in controlling and managing their portion of the network and permit flexible global connectivity.

PRIORITIES

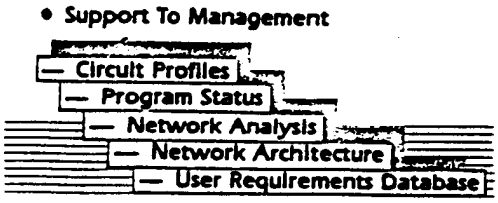
- **Crisis**
- **Substantive Core Systems**
- **Substantive Core Circuitry**
- **General Purpose Systems**
- **Special Purpose Circuitry**
- **Non-Substantive Systems**
- **Non-Substantive Circuitry**
- **Other**



The Working Group will be developing a comprehensive restoration priority system based upon the priorities illustrated above.

Modeling

The modeling initiated for planning the network will be helpful to the Level-two network control stations when they become operational.



Service Offerings

Services planned to all five levels of the system are depicted below:

	SECURE VIDEO CONFERENCING	VOICE (SECURE)	DATA/ RECORD	FAX	ELECTRONIC MAIL	FILE TRANSFER	TERMINAL/ TERMINAL
LEVEL 1	X	X	X	X	X	X	X
LEVEL 2	X	X	X	X	X	X	X
LEVEL 3	X	X	X	X	X	X	X
LEVEL 4			X	X	X	X	X
LEVEL 5			X	X	X	X	X

By properly managing the bandwidth and by minimizing the dedication of circuits to individual subscribers, the network will satisfy the needs of all customers on a cost-effective basis.

User Requirements

As expected, the definition of user requirements was difficult. The Working Group met regularly with Department of State and non-Department of State customers to review the services desired and the locations where the activities have representation. The Working Group also met with representatives of the Bureau of Administration, Information Systems Office (A/ISO), and the Information Technology Planning (A/ITP) staff. The meetings were held to determine their bandwidth needs, and identify activities for those whom they are brokering. This area is treated in depth in the body of the report.

PARTIAL LISTING OF DOS USERS

M/COMP(FMS)	FAIS	ISO	SY	Regional Bureaus
MED	CPU	TCU	FBO	Special
CA	S/S-VIP	INR	M/CTP	Security Coordinator

Non-DOS User Requirements by Agreements

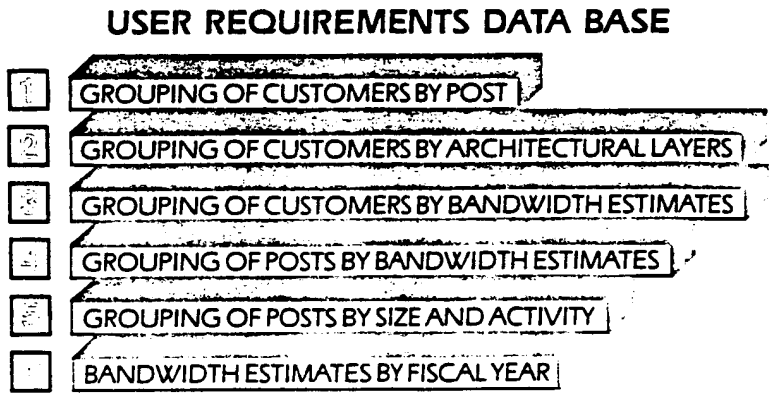
POSTS	AID	DEA	FAA	FAS	FBI	USDOC	USIA	OTHER
Approximately 75 Overseas Locations	24 (13)	12 (8)	12 and 24 (14)	24 (31)	0.075 to 24 (14)	24 (45)	12 where there is 96 more	0.3 to 24 (17)

Data Base

As requirements are defined, entries into a user requirements data base will be made.

Subsequently a process for validating requirements will be established, as well as the assignment of restoration priorities.

All U.S. Government activities requiring communications services through leased facilities to and from Foreign Service posts will be provided communications services by the DOS network.



Transmission

Availability of high-quality leased circuitry to all geographical areas is a limiting factor in implementing the proposed architecture, and the Working Group is examining several possibilities including commercially available Time Division Multiple Access Systems (TDMA). The Working Group has been meeting with the major International Record Carriers (ITT, COMSAT, AT&T, MCI, TRT, RCA, and others) in an attempt to assess their capabilities and to influence their future planning. The IRCs have been extremely cooperative and appreciative of being advised of the Department's intentions. Since divestiture, the ordering of circuits has created a significant workload on all parties involved.

The Working Group is taking advantage of the discussions with the IRCs to review various ways to shorten the cycle of ordering circuits. The most popular suggestion is to award a multi-year (e.g., five-year) contract to the IRCs by either geographical areas or by country. Once the contract is in place, orders can be issued and quickly satisfied.

Carriers also seem to prefer that the full (send and receive) circuit requirement be contracted to the U.S. carrier. Through their established contacts they would coordinate with the host government and the local PT&T activation for the entire circuit requirement. While this has been the traditional approach, some host governments now seem to prefer the government-to-government contact as opposed to the government-to-carrier contact, particularly in the case of on-premise satellite stations. Because of divesture, however, many more companies are bidding circuitry and each is attempting to deal with the local PT&T in the proposal process. Consequently, the host government workload has increased.

The government-to-government approach creates an appreciable increase of effort by the Department of State. Whichever approach is followed, it is considered important that an effective pattern be established if circuitry, in the magnitude being proposed, is to be ordered and put into operation in a timely fashion.

Hardware

Early in the deliberations of the Working Group it became apparent, as others have proposed, that some new software driven hardware would be required to better control and manage the Network. The Working Group has carefully assessed this need and concluded that the Department of State must utilize a Communications Network Processor.

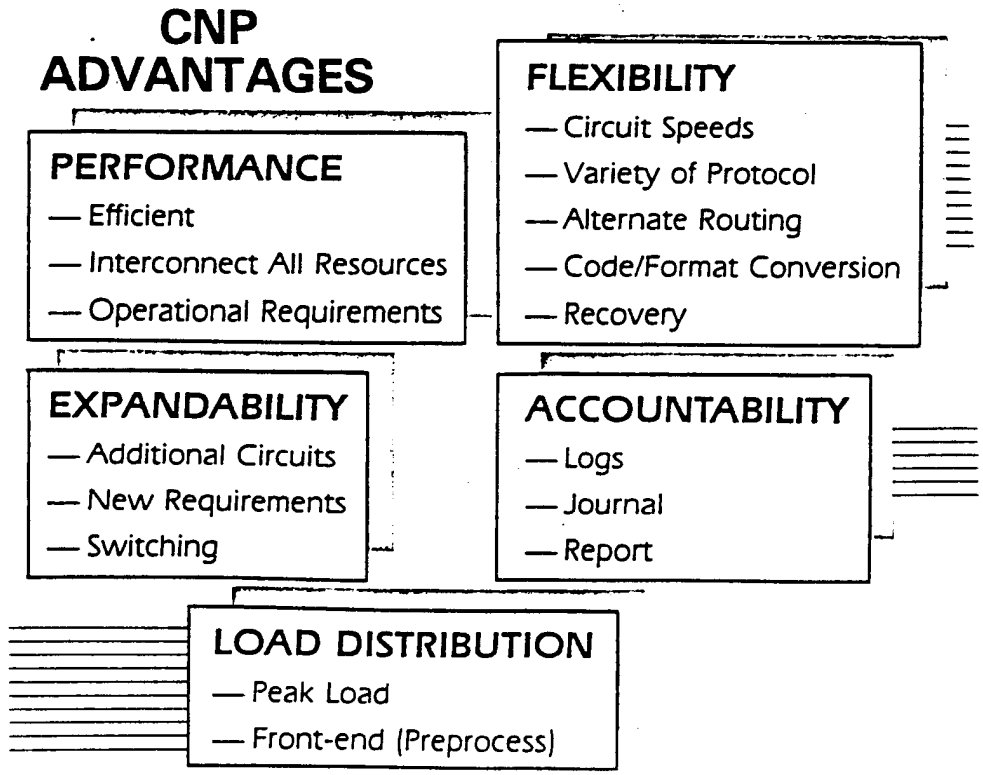
A Communications Network Processor (CNP) will be required at the Level-two hubs, the Level-three tier and at Level-four locations. Level-five posts will not require the CNP. The CNP would process a number of features, including the following:

- Assembly/Buffering
- Framing/Unframing
- Sequencing
- Flow Control
- Precedence Queuing
- Protocol Conversion
- Code/Format Conversion
- Transmission Error Control
- Switching
- Network Control/Recovery
- Access Control
- Transaction Record/Report
- Transparency.

Adopting the CNP is critical to the network design. In addition to the CNP functions, the network requires the utilization of a multiplex device for those applications such as TV and voice where the circuits will necessarily have to be dedicated for periods of time. The Working Group is examining the possibility of combining the CNP and multiplex functions into a single device for ease of logistical support and for cost reasons. The features of the CNP are not unique to the Department of State. Devices are on the market which contain some or all of the features. The Working Group is, therefore, proposing the issuance of a Request For Proposal (RFP) to contract the acquisition and integration of the CNP into the network. As a basis for the RFP, the Working Group issued a Request for Information (RFI) to a number of vendors to obtain information concerning their products. It is important to note that the Level-four posts need only a scaled-down model of the CNP. Also the Level-three CNP will be a streamlined version of that employed at the Level-two posts. Below is a rough estimate (full redundancy) of the quantities needed:

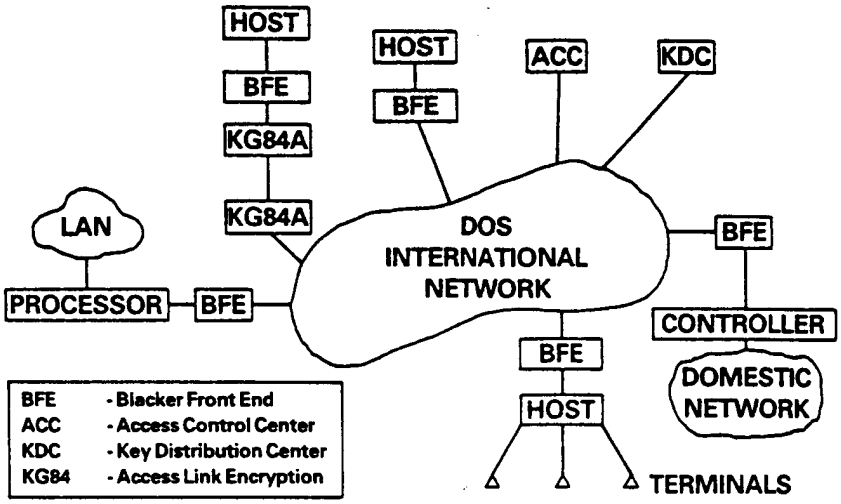
CNP (A-Model)	10 units
CNP (B-Model)	60 units
CNP (C-Model)	200 units

These quantities may require an initial one-time investment of $4 million a year over a four-year period.



In addition to the CNP, new hardware is required to maintain cryptographic synchronization on circuits where delays are encountered because of multiple satellite hops and to prepare the data for Packet Encryption. The long propagation delays of satellite links introduce an unacceptable delay in the path.

Typical Blacker Applications



The Working Group examined two ongoing government programs to determine their applicability in this area. NSA's BLACKER System initially showed some promise in solving the problem, but after further examination, major concerns arose because of the type of equipment in the DOS inventory. This is the device the Department of Defense (DOD) will use with the Defense Data Network (DDN). The Working Group would favor this avenue because NSA and DOD would have support mechanisms for this program. Because of the concern, however, the Working Group is examining other possibilities.

Coordination

The Working Group conducted a number of briefings over the past several weeks to representatives of interested activities:

- The DASC and A/OC Directors
- A/OC Components
- DTS Policy Board
- A/ITP (FAIS)
- A/ISO
- Customers (DOS and Non-DOS)
- IRCs
- DOS OC Regional Directors
- Special Activities

Also the Group had a number of meetings with other Departments and agencies to ensure that the approach taken allows for inter-operability.

Other Related Programs

The Working Group has developed a long-term network architecture needed by the Department to satisfy the requirements into the 1990's. To date the Group has not focused on current programs that relate to the long-haul networking. Three ongoing programs require examination to ensure that systems planned will accommodate the future design:

1. Alternate Communications Center with emphasis on the Central Technical Control Facility,
2. The management and implementation of the High-Speed Program and the Multiplex Equipment,
3. The Digital Telephone Exchange Program.

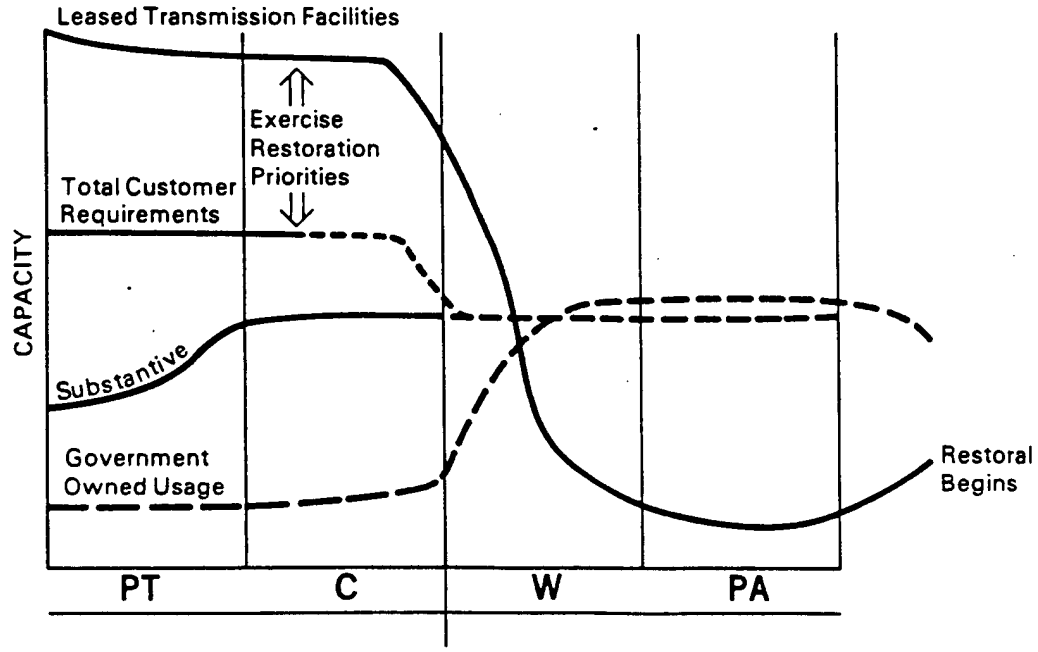
Program Management

The Working Group will continue its important work to implement the Network Architecture. The Working Group will be augmented with specialists from the government and the private sector.

Transmission Costs

The projection of recurring costs for transmission facilities to support the Network is estimated at $100-120 million. This amount would be offset significantly by the reduction of commercial international calls, the elimination of the LONDON TOLL dedicated-voice facilities, and the eventual phase-down of the present overseas message switches.

Network Availability Estimate



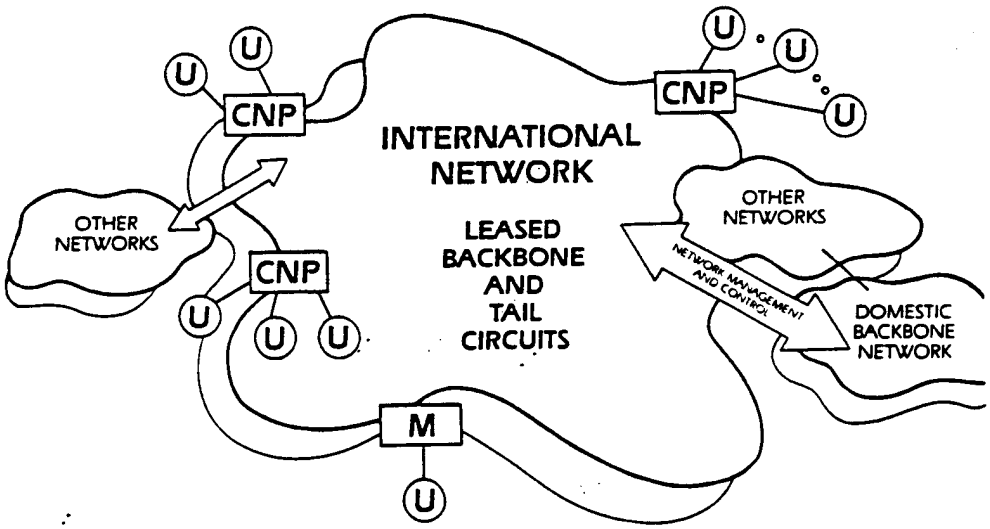
Summary

This document provides an overview—features and benefits—of a Network Architecture for the future, and an assessment of the influences—concerns and costs—that face managers considering the expansion of the Department's global telecommunications network. Aside from acquiring reliable transmission paths which are critical to the design of the enhanced network, a versatile Communications Network Processor (CNP) is needed to connect the customer equipment to the communications lines for data transfer in and out of the network and to manage the bandwidth effectively.

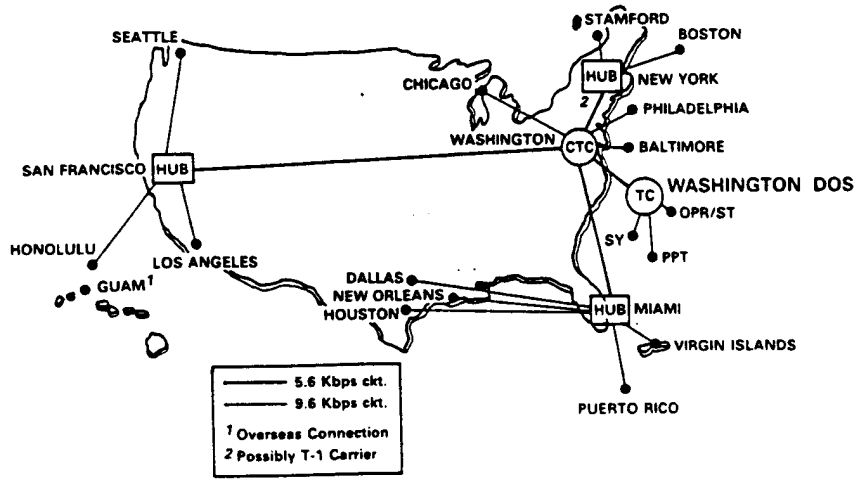
The network is an important asset of the U.S. Government and will operate into all countries in which the government has diplomatic relations. Compared with the past, the bandwidth may seem exhoribant, but the bandwidth proposed for microprocessors, as well as the growing dependence of all agencies on data communications as an essential component of their day-to-day operatons and special requirements, supports a network of this magnitude.

The network is envisioned as evolving into a high-capacity integrated data network with other media operations to meet 1990 requirements.

State Telecommunications Network



Proposed Interim Domestic Network Configuration

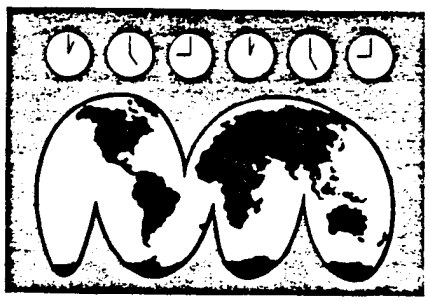


Telecommunications in Transition

The Department is ACCELERATING its application of NEW telecommunications techniques to meet its obligation as an

INTERNATIONAL CARRIER.

The Carrier role of the Department is becoming more complex, extremely important and growing significantly.



Communicate anywhere, anytime